

Super Lightweight Tank Monitor Assessment

April 09, 1997

Version 1.0

SLWT Monitor Thread

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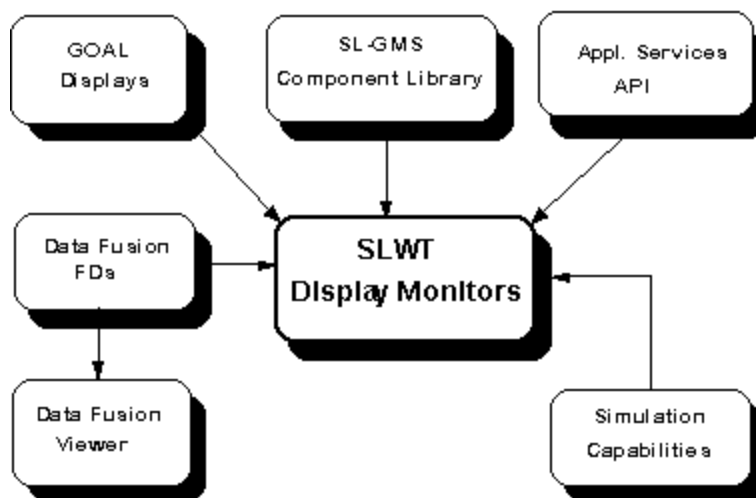
1. Introduction

1.1 Super Lightweight Tank Monitor Overview.

The Super Lightweight Tank (SLWT) Monitor Thread's purpose is to demonstrate the capability of the CLCS System (from gateway to HCI) using display monitor applications for the Shuttle vehicle/GSE systems involved in the SLWT Test. The major system functions to be demonstrated will be the display function capability using the SL-GMS dynamic data visualization tool, data health, data fusion, data distribution and the consolidated systems gateway.

1.2 Super Lightweight Tank Monitor Concept

The Super Lightweight Tank Monitor Thread draws upon the foundation of several previous and concurrent threads to provide a capability for monitoring Shuttle vehicle and ground support equipment data during an External Tank tanking test (targeted for the SLWT test). The following diagram illustrates the dependencies of the development effort.:



The display monitors will be based on similar GOAL display skeletons/programs and will use all of the capabilities of SL-GMS to provide showcase applications. Data fusion and data health capabilities will be incorporated into the displays as appropriate to make implementation as simple as possible while providing all appropriate information. To support the goal of developing display monitors in a rapid development environment, an SL-GMS component library will serve as a starting point for all display elements.

NOTE: These SLWT display monitors are for data monitoring only. Vehicle/GSE command and control capabilities will not be supported.

1.3 Super Lightweight Tank Monitor Specification

The following high-level requirements are from the Redstone Statement of Work, Revision 1.0, released 22 February 1997:

1. Define and implement the Users Displays to support the SLWT test.

2. Define and implement the demonstration data fusion FDs (and their algorithms) required to support the SLWT test.
3. Define the GMS/Metro unique FDs and provide the system and application services to support them for the SLWT test.
4. Demonstrate data health as it relates to the SLWT user display FDs.
5. Define and implement the demonstration FDs health (and their algorithms) required to support the SLWT test.
6. Develop the Concept of Operations for support of the SLWT test.
7. Define and provide the hardware requirements for supporting the SLWT test (including OIS, OTV, etc.).
8. Provide an updated Basis-Of-Estimate for the display development effort for all Application Software Sets.

1.4 Super Lightweight Tank Monitor Summary

The SLWT Monitor thread capability depends on several threads, being worked separately, to ensure success. Without the services provided by these threads being available when required (as reflected on the development schedule), the SLWT Monitor Thread cannot be successful.

- Data Fusion Thread
- FD Data Distribution Thread
- Simulation Interface to RTCN Thread
- User Display Monitor and Plotting Thread
- Data Health

The following items summarize the areas where additional work is required to provide the SLWT Monitor Thread capabilities.

1. Common Applications Support CSCI

This CSCI may be modified during the development of the SLWT display monitors if additional building blocks are identified that lend themselves to the reuse criteria established in the User Display and Plotting Thread. At this point in time, there is no indication of what, how many or to what extent modification will be required. As additional components are identified, they will be created or modified, tested and added to the library.

2. SLWT CSCI

This is the primary CSCI involved in this thread capability. Products developed as part of this CSCI will address the following Statement of Work items:

- Define and implement the Users Displays to support the SLWT test.
- Define and implement the demonstration data fusion FDs (and their algorithms) required to support the SLWT test.
- Define the GMS/Metro unique FDs and provide the system and application services to support them for the SLWT test.
- Demonstrate data health as it relates to the SLWT user display FDs.
- Define and implement the demonstration FDs health (and their algorithms) required to support the SLWT test.
- Provide an updated Basis-Of-Estimate for the display development effort for all Application Software Sets.

3. Concept of Operations

The Concept of Operations document will address the following Statement of Work items:

- Develop the Concept of Operations for support of the SLWT test.
- Define and provide the hardware requirements for supporting the SLWT test (including OIS, OTV, etc.).

1.5 Super Lightweight Tank Monitor Hardware Diagram

The following hardware elements must be available to support integrated testing, user validation and the final demonstration:

- HCI Workstation
- DDP
- Gateway (for vehicle/GSE/consolidated data)

Additional hardware requirements necessary to support the SLWT test, will be defined in the SLWT Concept of Operations document.

1.6 Super Lightweight Tank Monitor Deliverables

The following products will be delivered to satisfy the requirements of this thread capability:

1. Display Monitors (SL-GMS source and executable) for the following systems:
 - LH2
 - LO2
 - MPS/SSME
 - HAZGAS
 - Surface Ice
 - GMS/Metro
2. A list of data fusion Function Designators with their associated algorithms (provided in documentation format).
3. An updated Common Applications Support Library that will include any new/modified reusable resources developed during this effort.
4. An updated Basis-Of-Estimate to reflect adjusted display monitor development manpower estimates based on the metrics gathered during this effort.
5. A Concept of Operations document that will delineate how the SLWT display monitors will be used to support a tanking test and will describe any specific test support requirements.

1.7 Super Lightweight Tank Monitor Schedule

The Super Lightweight Tank Monitor thread development schedule is attached at the end of the thread description document.

1.8 Super Lightweight Tank Monitor Simulation Requirements

In order to properly debug and validate the display monitors, a limited simulation capabilities (either a simulation model or a data stream “stuffing” technique) are required for the following Shuttle vehicle/GSE systems:

- LH2
- LO2
- MPS/SSME
- HAZGAS

- GMS/Metro
- Surface Ice

Data fusion FDs must also be supported in the simulation environment, or a viable workaround devised.

Connectivity of the simulation environment to the software development environment is required to support debug and validation.

1.9 Super Lightweight Tank Monitor Training Requirements

All training required to support development of the display monitors for this thread has been previously procured and completed.

End users will require a familiarization training on operation of the HCI and manipulation of the display monitors.

1.10 Super Lightweight Tank Monitor Facilities Requirements

The following facilities will be required to support integrated testing, user validation and the SLWT test:

1. IDE (for integrated testing and user validation)
2. LCC-X (for demonstration/use of the product)

1.11 Super Lightweight Tank Monitor Procurement

None

1.12 Super Lightweight Tank Monitor Action Items/Resolution

There are no open action items at this time.

2. CI Assessments

2.1 Super Lightweight Tank Display CSCI Assessment

The Super Lightweight Tank CSCI is an interim CSCI that contains elements from the following systems: LH2, LO2, MPS/SSME, HAZGAS, Surface Ice and GMS/Metro. These display monitors will illustrate the capabilities of the SL-GMS development tool, will demonstrate the features of data fusion and data health and provide monitor capability to support a tanking test (with the SLWT test being targeted).

To preclude the necessity of a full functional requirements definition for each system at this phase of the project, these displays will be delivered as a separate CSCI independent of any Shuttle vehicle/GSE subsystem CSCI. When the associated vehicle/GSE subsystem CSCIs start implementation, the display monitors created as part of the SLWT CSCI will be included with any necessary modifications.

Because of the “transient” nature of these display monitors, formal requirements documentation will not be developed or delivered. Where possible, the CLCS display monitors will use an equivalent GOAL display skeleton/program as the basis for their development. The intention here is to use the GOAL displays as an indication of what data needs to be displayed and how Shuttle Engineering wants it displayed. From that basis, the full capabilities of SL-GMS will be used to enhance the display appearance and to provide a more efficient mechanism for data display. Every effort will be made to maintain any display element identifiers that are referenced in OMIs to reduce the amount of revision necessary to those OMIs. The display implementers will work closely with their Shuttle Engineering counterparts to ensure proper implementation. The lessons learned during this development effort will be used to improve the development process for all future CSCIs.

LH2 Display Monitor Development

One display monitor will be developed for the LH2 system which will include both GSE and vehicle components/data. Specific display attributes will be defined prior to the next design panel phase.

LO2 Display Monitor Development

One display monitor will be developed for the LO2 system which will include both GSE and vehicle components/data. Specific display attributes will be defined prior to the next design panel phase.

MPS/SSME Display Monitor Development

Two display monitors will be developed for the MPS/SSME system. Specific display attributes will be defined prior to the next design panel phase.

HAZGAS Display Monitor Development

Two display monitors will be developed for the HAZGAS system which will include both GSE and vehicle components. Specific display attributes will be defined prior to the next design panel phase.

Surface-Ice Display Monitor Development

One display monitor will be developed for the External Tank Surface Ice Team. Specific display attributes will be defined prior to the next design panel phase.

GMS/Metro Display Monitor Development

One display monitor will be developed for the GMS/Metro systems to monitor the ET pinch load measurements during tank loading. Specific display attributes will be defined prior to the next design panel phase.

CSCI Assessment

Function Name	CSCI Labor (EP)	% of CSCI	Function EP
LH2 Display Monitor	0.75	100%	0.75
LO2 Display Monitor	0.75	100%	0.75
MPS/SSME Display Monitor	1.5	100%	1.5
HAZGAS Display Monitor	1.5	100%	1.5
Surface-Ice Display Monitor	0.5	100%	0.5
GMS/Metro Display Monitor	0.5	100%	0.5

Manpower resources will be allocated as follows:

1. During the initial display monitor development, one Software Engineer will be assigned to work full-time with Shuttle Engineering representatives from two systems.
 - 4 Software Engineers full time for 1.5 months
 - 6 Shuttle Engineers part time for 2.5 months (includes requirements definition)
2. After the bulk of the display monitors have been developed and tested, one Software Engineer will be assigned to handle the “fine tuning” of all displays and to support the validation effort.
 - 1 Software Engineer full time for 1 month
 - 6 Shuttle Engineers part-time for 1 month

Lines of Code

SL-GMS display monitors are primarily graphic oriented with background functions specified in an SL-GMS specific scripting language. As such, a LOC estimate is not a good indication of component size. We are in the process of determining a viable method for estimating size.

Documentation

Since this is a demonstration CSCI and the displays developed may or may not become part of the associated system's final CSCI, no formal documentation will be developed or delivered.

Assumptions

The following assumptions were made during this initial assessment of the Super Lightweight Tank Monitor Thread.

1. The Application Services API must be defined/available for use by the dates indicated on the schedule. Without this capability, display development cannot proceed any further.
2. Data Fusion capability must be available for use by the date indicated on the schedule to allow for debug of the data fusion algorithms.
3. Simulation capability (or some substitute) must be available for use by the date indicated on the schedule to allow for debug and validation of the display monitors.

Open Issues

There are no open issues at this time.

2.2 Display Component Library CSCI Assessment

The Application Software Display Monitors will be developed using the SL-GMS dynamic data visualization tool set. This CSCI provides a library of graphic sub-models and display routines that can be reused by multiple disciplines to assist in the rapid development of user display monitors. For the SLWT Monitor Thread, it may be necessary to add new components to this library or modify existing components based on new requirements.

Sub-Model Component/Routine Library Development

As additional components are identified during the development of the SLWT display monitors, the process identified during the User Display and Plotting Thread will be used to implement and add the component to the library. At this point in time, there is no way to estimate the effort this might require since the current size of the library is unknown and the amount of modification/additions that might be necessary cannot be estimated until implementation of the display monitors has been started.

The initial delivery of the sub-model component/routine library will be developed as follows:

CSCI Assessment

Function Name	CSCI Labor (EP)	% of CSCI	Function EP
Common Application Support Library Development	.5	100%	.5

Lines of Code

SL-GMS displays are primarily graphic oriented with background functions specified in an SL-GMS specific scripting language. As such, a LOC estimate is not a good indication of component size. We are in the process of determining a viable method for estimating size.

Documentation

Each sub-model component/routine will have a documentation page associated with it that contains the following information:

1. Description of the component/routine
2. List of all associated variables that the user must change for the component to function properly.
3. Description of any dynamic behavior and how to modify it if necessary.

4. A picture of the component

The documentation page will be part of the library web browser function.

Assumptions

None

Open Issues

None at this time.

3. COTS Products Dependencies

3.1 SW Products Dependency List

All display monitors for the Super Lightweight Tank Monitor Thread capability will be developed using the Sherrill-Lubinski Graphical Modeling System (SL-GMS) Dynamic Data Visualization Tool.

3.2 HW Products Dependency List

None